D H E C
PROMOTE PROTECT PROSPER
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Columbia, SC 29201-1708

TO: John T. Litton, P.E., Director
Division of Waste Management
Bureau of Land and Waste Management

THRU: David Scaturo, P.E., P.G., Manager
Corrective Action Engineering Section

FROM: Jerry Stamps, Engineer Associate
Corrective Action Engineering Section

DATE: September 18, 2003

RE: Evaluation of Charleston Naval Complex Status Under
The RCRA Info Corrective Action Environmental Indicator
Event Codes (CA725 and CA750)
EPA ID No. SC0 170 022 560

CC: Mansour Malik, RCRA Hydrogeology Section
Caron Falconer, EPA Region 4
Narindar Kumar, EPA Region 4
Dan Spariosu, EPA Region 4
Rob Harrell, P.E., SOUTHDIV

I. PURPOSE OF MEMO

This memo is written to formalize an evaluation of the status of Charleston Naval Complex (CNC) in relation to the following corrective action event codes defined in the Resource Conservation and Recovery Act Information System (RCRA Info):

1.) Current Human Exposures Under Control (CA725),

2.) Migration of Contaminated Groundwater Under Control (CA750).

Concurrence by the Director of the Division of Waste Management is required prior to entering these event codes into RCRA Info. Your concurrence with the interpretations provided in the following paragraphs and the subsequent recommendations is satisfied by dating and signing at the appropriate location within Attachment 1.

II. HISTORY OF ENVIRONMENTAL INDICATOR EVALUATIONS AT THE FACILITY AND REFERENCE DOCUMENTS

This particular evaluation is the third evaluation for CNC. The earlier evaluations were dated September 18, 1997 and April 11, 2002. The April 2002 evaluation is attached. The results of this earlier evaluation recommended that CA725 NO and CA750 NO be entered into RCRA Info (then RCRIS) due to the fact that human exposures to contamination were not currently controlled for soil, groundwater, and surface water, and also due the uncontrolled migration of contaminated groundwater at the facility.

The results of this evaluation are based on information obtained from the documents identified in Attachment 4:

III. FACILITY SUMMARY

The Charleston Naval Complex was closed on April 1, 1996 and was renamed the Charleston Naval Complex (CNC). The CNC consists of 1,588 acres and is located along the Cooper River in Charleston County, South Carolina. The CNC is divided into 12 zones (alphabetically from Zone A to K) to facilitate RCRA corrective action processes and for conveyance of the property for redevelopment. The CNC operated approximately 18 major industrial shops. The hazardous waste generated primarily included paint waste, waste solvents, boiler cleaning solutions, acids, sludge from metal plating at the ship pretreatment facility, and small quantities of mixed waste (radiologically contaminated hazardous waste).

The CNC corrective action program is governed by the RCRA Permit (SC0 170 022 650), issued by the SCDHEC on August 17, 1998 (last modified April 25, 2003). Appendix A of the referenced permit lists the 196 solid waste management units (SWMUs) and 209 areas of concern (AOCs) identified at the CNC that are in various stages of corrective action.

The EPA generated a National Corrective Action Priority System (NCAPS) ranking for the site in March of 1992. The result of this ranking was a high rating. SCDHEC conducted an environmental indicator (EI) evaluation of the CNC on September 18, 1997. This evaluation examined plausible human exposure, groundwater migration, surface water contamination, and whether controls are in place to prevent exposure at the facility.

IV. CONCLUSION FOR CA725

As outlined in Attachment 1, there are currently no complete human health exposure pathways to contamination at the Charleston Naval Complex. This conclusion is based on current conditions and data, and is summarized for soil, sediment, groundwater, surface water, and air media below.

Soil and Sediment

As stated above, CNC is divided into 12 Zones. Zone E is designated for industrial re-use. Industrial re-use will be maintained by Land Use Controls (LUCs). Investigations at many sites located within Zone E have not resulted in chemical concentrations greater than the EPA Region III Industrial RBC or background, as appropriate. Sites with contamination greater than the Industrial RBC have been remediated to industrial standards via interim measures. With the exception of the landfill, site investigations for the remainder of the

base have been conducted with respect to the EPA Region III Residential RBCs. Based upon the information available to date, any contamination in excess of the Residential RBCs or background, have been remediated. It is anticipated that the landfill will be subject to industrial re-use; therefore, the landfill investigation was conducted with respect to industrial standards. There is no known direct exposure to the waste material contained within the landfill, nor are there any Industrial RBC exceedances in the current soil cover. Consequently, the soil and sediment at CNC are not expected to be a threat to human health.

Groundwater

Groundwater is not currently used as a drinking water source, nor is it used for irrigation. The Navy currently has a dig permit process in place to prevent the unauthorized installation of wells and land disturbance. Consequently, the groundwater at CNC does not pose a threat to human health.

Surface Water

Surface water sampling at various SWMUs/AOCS throughout the base has not resulted in contamination above the relevant human health action levels. Therefore, surface water at CNC does not pose a threat to human health.

Air

Releases to air from soil, groundwater, sediments, and/or surface water contaminated by SWMUs or AOCs at CNC are not known to have occurred or be occurring above relevant action levels.

Based on the information provided above, it is recommended that CA725 YE be entered into RCRA Info for the MCRD.

V. CONCLUSION FOR CA750

Shallow, intermediate, and deep zones of the surficial aquifer had detections of metals and solvents above their respective Maximum Contaminant Levels (MCLs). Major areas affected include the west boundary (SWMU 39) of the CNC, which is adjacent to a marsh and close to a residential area, AOC 607 in Zone F, adjacent to a residential property, SWMU 196 in Zone H discharging contamination into Shipyard Creek, and the Naval Annex property. At this time, no controls are in place to stop the groundwater from migrating off site or to prevent access to the marsh area, Shipyard Creek, and the headwaters of Noisette Creek. Based on the above information, it is recommended that CA750 NO remain in RCRA Info for the CNC.

VI. SUMMARY OF FOLLOW-UP ACTIONS (Discussion of What is Needed to Get to Yes, with EI Interim Milestone Schedule)

A. CA750 – Additional groundwater data is necessary to demonstrate that contaminated groundwater is not migrating. This will be accomplished by collecting groundwater samples from existing wells, installing new wells as necessary, or implementing corrective measures to prevent further migration.

SWMU/AOC Number	Activities (Events as Defined in RCRIS)	Activity CA RCRIS Event Code	Scheduled Date (QTR & FY)	EI Code (725/750)	Remarks
39	CMI Work Plan Approved, Stabilization Measure Implemented [OE&S]	CA 500, CA 600	12/31/03, 3/31/04	750	Contaminated groundwater plume off-site migration control
25/70	CMI Work Plan Approved, Stabilization Measure Implemented [OE&S]	CA 500, CA 600	12/31/03, 3/31/04	750	Remedy to be selected in CMS, Implemented with CMI process
65	CMI Work Plan Approved, Stabilization Measure Implemented	CA 500, CA 600	12/31/03, 3/31/04	750	Remedy to be selected in CMS, Implemented with CMI process
607	CMS Report Approved, CMI Work Plan Approved	CA350, CA500	12/31/03, 3/31/04	750	DNAPL source reduction and plume migration control
196	CMS Report Approved, CMI Work Plan Approved	CA350, CA500	12/31/03, 3/31/04	750	Source area reduction and contaminated groundwater to surface water migration control
166	CMS Report Approved, CMI Work Plan Approved	CA350, CA500	3/31/04, 6/30/04	750	Source area reduction and contaminated groundwater off-site migration control
	Migration of Contaminated Groundwater Under Control	CA750	12/31/04	750	Revised EI Memorandum

VII. LEVEL OF CONFIDENCE IN REACHING A POSITIVE EI EVALUATION AND MAJOR ISSUES

The Department is reasonably confident that the facility can achieve a CA750 YE determination in 2004. This can be accomplished by establishing an appropriate monitoring well network and implementing Interim Measures as necessary.

DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA725)

Facility Name: **Charleston Naval Complex**
Facility Address: PO BOX 190010
North Charleston, South Carolina 29406
Facility EPA ID#: SC0 170 022 560
Updated: September 16, 2003

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g. from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)) been considered in this EI Determination?

   Yes.

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **"contaminated"** above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs, or AOCs)?

Media	**Yes**	**No**	**?**	**Rationale/Key Contaminants**
Groundwater	**X**			Cr^{+6},TCE, Zn, As, Pb, PaH's see comment (1)
Air (Indoors)		**X**		See comment (2)
Surface Soil (<2ft)	**X**			PaH's, Pb, As, Zn
Surface water	X			See comment (3)
Sediment	**X**			Cr^{+6}, TCE, Zn, As, Pb see comment (1)
Subsurf. Soil (>2ft)	**X**			Cr^{+6}, TCE, Zn, As, Pb See comment (1)
Air (Outdoors)		**X**		See comment (4)

Rationale and Reference(s):

Comment 1. The key contaminant listing for groundwater, surface soils, sediments, and subsurface soils is not inclusive. These are the primary contaminates. Each SWMU and AOC has a separate list of Contaminants of Potential Concern (COPCs) and Contaminants of Concern (COCs).

Comment 2.Testing conducted during occupation of Building 225 indicates that the indoor air is below acceptable risk-based criteria at Building 225. The use of BLDG 225 as a dwelling is now prohibited by deed restriction. All other buildings that may be over or near subsurface contamination are industrial or commercial buildings. Please see the attached Indoor Air Evaluation.

Comment 3. While operational Charleston Naval Complex was in compliance with its NPDES permit.

Comment 4. Charleston Naval Complex does not have any regulated air emission sources

References. See attachment 1.

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonable expected under the (land-and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table
Potential **Human Receptors** (Under Current Conditions)

Contaminated Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food[1]
Groundwater	No	No	No	**Yes**	No	No	No
Air (indoors)	No	No	No	No	No	No	No
Soil (<2ft)	No	Yes	No	**Yes**	**Yes**	No	No
Surface water	No	No	No	No	No	No	No
Sediment	No	No	No	No	No	No	No
Soil (>2)	No	No	No	**Yes**	No	No	No
Air (outdoors)	--	--	--	--	--	--	--

[1] Food production is not currently practiced at CNC. Fishing advisories, if needed, are issued by the South Carolina Department of Natural Resources (SCDNR).

Rationale and References:
Groundwater: Groundwater is not used as a potable water source. Potable water is provided by the Charleston Commissioners of Public Works from other sources. Therefore only construction worker are exposed to the superficial aquifer. DHEC regulated deep well are used for turf irrigation. The water from these well is from a deep aquifer. Water quality testing is required by DHEC.

Air (indoors): The potential for indoor air pollution from RCRA Corrective Action source was evaluated during the RCRA Facility Investigation (RFA). Only one inhabitable dwelling, BLDG 225, was identified with the potential for indoor air pollution above risk-based criteria. Building 225 is currently un-

occupied and its use as an inhabitable dwelling is prohibited by deed restriction. Please see the attached Indoor Air Questionnaire.

Surface Soil (<2ft): The surface soils contamination is limited largely to the industrial areas of CNC. The exposure pathway is broken by fencing of the industrial areas, limiting the Day-Care to an enclosed (by fence) area in a residential area. The areas that are not fenced separately are isolated by location such as the dredge management area. Furthermore, it should be noted that Interim Measures are currently ongoing to remove contaminated surface soil. Therefore, only construction workers, trespassers, and workers have a reasonable pathway for exposure

Surface water: The surface waters adjacent to CNC are regulated by DHEC. CNC discharges, when CNC was active, were control by a NPDES permit. The surface waters adjacent to CNC are not suitable for swimming or bathing, due to ocean going ship traffic, ship construction, etc.

Sediments: The surface waters adjacent to CNC are not suitable for swimming or bathing, due to ocean going ship traffic, ship construction, etc; therefore, there is not a complete exposure pathway to sediments.

Subsurface soils: Only construction workers have a reasonable exposure to contaminated subsurface soils.

Air (outdoors): There are no active air emission sources from the US Navy at CNC.

4 Can the **exposure** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"** (i.e., potentially "unacceptable" because exposure can be reasonably expected to be: 1) greater in magnitude (intensity, frequency, and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above he acceptable "levels") could result in the greater acceptable risk)?

If **NO** (exposure can not be reasonable expected to be significant (i.e., potentially "unacceptable") for any complete pathway) – skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination: (identified in #3) are not expected to "be significant".

XXX If **YES** (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) – continue after providing a description (of each potentially

"unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant.

____ If unknown (for any complete pathway) – skip to #6 and enter "IN" status code.

Rationale and Reference(s):

Exposure pathways are complete only for the construction worker, the trespasser, and worker. For the Construction worker the complete exposure pathways are for groundwater, surface soils and subsurface soils. For the trespasser the complete exposure pathway is for surface soils. The worker is reasonably expected to be exposed to only surface soils.

Construction worker exposure to groundwater, surface soils, and subsurface soils is control by:

All construction work in areas that are known or suspect SWMUs or AOCs requires Navy approval, in writing, before the work begins. Part of the approval process includes identifying known and suspected areas of contamination, listing the suspected contamination, and stating how exposure to the contaminant will be controlled (i.e., personal protection equipment (PPE), engineering controls, etc.)

All users of properties that are being re-used by either license or lease have been notified in the Environmental Baseline Survey (EBS), that is part of license or lease agreement of the SWMUs or AOC within one-quarter mile of the property. Digging and other restrictions in the license or lease agreement prohibit the disturbing of the groundwater, surface soils, and subsurface soils without Navy approval, in writing. The approval process requires the property user to describe how exposures to the known or suspect contaminates will be controlled.

Therefore, the construction worker exposure is not considered significant.

Trespasser exposure to surface soils is controlled by:

All of CNC is fenced and patrolled by security guards. Access to CNC is limited during normal working hours to those without a specific work location.

Areas with significant contaminated soils within CNC are further isolated by fences, groundcover such as turf grasses, roads, parking lots, and building foundations.

Therefore, the trespasser exposure to surface soils is not considered significant.

Worker exposure to surface soils is controlled by:

Areas with significantly contaminated soils within CNC are isolated by fences, groundcover such as turf grasses, roads, parking lots, and building foundations.

contaminated surface soil, worker exposure to contaminated surface soil is not expected to be significant.

Therefore, the worker exposure to surface soils is not considered significant.

6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA 725), and obtain Supervisor (or appropriate Manager) signature and the date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

XXX YE – Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to the "Under Control" at the Charleston Naval Complex facility, EPA ID# SC0 170 022 560, located at North Charleston, South Carolina under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes.

___ NO – "Current Human Exposures" are NOT "Under Control."

___ IN- More information is needed to make a determination.

Completed by _____ Date 9/24/03
Jerry Stamps, Engineer Associate
Corrective Action Section
South Carolina Department of Health and Environmental Control

Supervisor Susan Byrd for David Scaturo Date 9/24/03
David Scaturo, Manager
Corrective Action Section
South Carolina Department of Health and Environmental Control

Locations where References may be found:

Southern Division, Naval Facilities Engineering Command
Caretaker Site Office
1895 Avenue F
North Charleston, South Carolina

Contact telephone and E-mail

US Navy
Robert A. Harrell Jr.
(843) 743-2063
HarrellRA@efdsouth.navfac.navy.mil

SCDHEC
Jerry Stamps, Engineer Associate
(803) 896-4285
stampsjm@dhec.sc.gov

Primary Screening – Question #1

Q1: Are chemicals of sufficient volatility ant toxicity known or reasonably suspected to be present in subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the ground water and/or capillary fringe-see Table 1)? (We recommended this consideration involve DQOs (see Appendix A) used in acquiring the site data as well as an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B).)

XXX If **YES** – check here, check the relevant chemicals on Table 1, and continue with Question 2. The chemicals identified hare (and any degradation products) are evaluated as constituents of potential concern in subsequent questions.

____ If **NO** – check here, provide rationale and reference below, and go to the Summary Page to document that the subsurface vapor to indoor pathway is incomplete (i.e., no further consideration of this pathway is needed); or

____ If sufficient data are not available, go to the Summary Page and document the need for more information. After collecting the necessary data, Question 1 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Rationale and References: See...

Primary Screening – Question #2

Q2 Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located *near* (See discussion below) subsurface contaminants found in Table 1?

____ If YES-check here, identify buildings and/or areas of concern below, and document on the Summary Page whether the potential for impacts from the vapor intrusion pathway applies to the currently inhabited buildings or areas of concern under reasonably anticipated future development scenarios, or both (Note that for EI considerations, we recommend only current risks be evaluated). Then proceed with Question 3 below.

XXX If NO-check here, describe the rationale below, and then go to the Summary Page to document that there is no potential for the vapor intrusion pathway to impact either the currently inhabited building or areas of concern under future development scenarios (i.e. no further evaluation of this pathway is needed). (Note that for EI considerations, only current risks are evaluated.); or

____ If sufficient data are not available-check here and document the need for more information on the Summary Page. After collecting the necessary data, Question

2 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Identify Inhabited Buildings (or Areas With Potential for Future Residential Development) Within Distance of Possible Concern: In the text of the guidance for this worksheet, EPA defines an inhabited buildings as a structure designed and used for dwellings. Included in this definition are single and multi-family homes, hospitals, schools, hotels, and similar facilities. The buildings near SWMUs 163 and 166 in the Naval Annex are used by the Marine Corp Reserve for administration, maintenance, and training. They are not used to provide residents for the reservist. Therefore, these buildings do not meet the definition, for this worksheet, of inhabited.

Primary Screening Stage – Question #3

Q3. Does evidence suggest immediate action may be warranted to mitigate current risks?

____ If YES-check here and proceed with appropriate actions to verify or eliminate imminent risks. Some examples of action may include but are not limited to indoor air quality monitoring, engineered containment or ventilation systems, or relocation of people. The action(s) should be appropriated for the site-specific situation.

____ If No-check here and continue with Question 4.

Rationale and Reference(s):

A. Secondary Screening – Question #4: Generic Screening

Q4(a): Are indoor air quality data available? (Collection of indoor air quality data without evidence to indicate the potential for vapor intrusion from subsurface source is not recommended at this level of screening, but if such data are available, we recommend they be evaluated along with the available subsurface data).

____ If **YES** – check here and proceed to **Question 4(b).**

____ If **NO** – check here and proceed to **Subsurface Source identification-Question 4(c).**

Q4(b): Do measured indoor air concentration of constituents of potential concern identified in Question 1 (and any degradation products) exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)?

____ If **YES**-check here, document representative indoor air concentration on Table 2, and **initiate a site-specific assessment** following the guidelines in Question 6. (We recommend the user also proceed with the subsurface evaluation to evaluate whether there is sufficient evidence to indicate that elevated indoor concentrations are due to vapor intrusion from subsurface sources, and not from background or other sources).

____ If **NO**-check here and proceed to **Subsurface Source Identification-Question 4(c).** (Here, the recommendation to proceed with the subsurface evaluation is based on the assumption that only limited indoor air data are available and, therefore, the available subsurface data need to be evaluated to ensure that all possible areas potentially affected by the vapor intrusion pathway are evaluated. However, in our judgment, if the site has been adequately characterized and sufficient indoor air data are available (see Question 6 for a discussion of data needs) the **pathway is incomplete** and/or does not pose an unacceptable risk to the human health, and no further assessment of the pathway is recommended. Document the finding as described in Question 6.)

Subsurface Source Identification

Q4(c): Is the any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table? (In our judgment, if there is a contaminant source in the unsaturated zone, soil gas are needed to evaluate the vapor intrusion pathway in the vicinity of the source and, consequently, use of the groundwater target concentrations may be inappropriate, However, we recommend that groundwater data still be evaluated, particularly if a contaminant plume extends beyond the unsaturated zone source, but that the evaluation be performed only in conjunction with an evaluation of soil gas data. Other vapor sources that typically make the use of groundwater target concentrations inappropriate include 1) those originating in landfills where methane may serve as a carrier gas; 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in significant advective transport of the vapors

____ If **YES**-check here and skip to **Soil Gas Assessment-Question 4(g)** below.

____ If **NO**-check here and continue with **Groundwater Assessment-Question 4(d).**

Groundwater Assessment:

Q4(d): Do measured or reasonably estimated groundwater concentration exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)? (For more information on the use of data for this part, please see the

sections below entitled "How should data be used in the question?" and "How do you know you have unusable data?".)

____ If **YES** (or if the detection limit for any constituents of potential concern is above the target concentration)-check here and document representative groundwater concentrations on Table 2. If **soil gas data are available**, proceed to **Soil Gas Assessment-Question 4(g)** below, otherwise proceed to **Question 5**.

____ If **NO**-check here and **proceed to Question 4(e)**.

Q4(e): Is the **nature and extent of groundwater contamination adequately characterized** (see Appendices A & E) in areas within inhabited buildings (or areas with the potential for future development of inhabited buildings)?

____ If **YES**-check here and continue with **Question 4(f)** below.

____ If **NO**-check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accordance with proper DQOs. Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Q4(f): Are there site conditions and/or data limitations that make the use of the generic groundwater attenuation factors inappropriate? We recommend this consideration involve comparison of the generic conceptual model to an appropriately scaled and update Conceptual Site Model (CSM) for vapor intrusion (see Appendix B), as well as the proper DQOs (see Appendix A). We also recommend evaluation of the generic attenuation factors used to develop the media-specific attenuation factors (see the section below entitled "What is in Tables 2(a), 2(b), and 2(c) and how did we develop them?" and Appendix F.)

Factors that, in our judgment, typically make the use of generic groundwater attenuation factors inappropriate include:

- Very shallow groundwater sources (e.g., depths to water less than 5 ft below foundation level); or
- Relatively shallow groundwater sources (e.g., depths to water less than 15 ft below foundations), and one or more of the following:
    - Building with significant openings to the subsurface (e.g., sumps. Unlined crawlspaces, earthen floors), or
    - Significant preferential pathways, either naturally-occurring and/or anthropogenic (see discussion blow under "What Should I Keep in Mind When Evaluating Data"), or
    - Buildings with very low air exchange rates (e.g., <o.25/hr) or very high-sustained indoor/outdoor pressure differentials (e.g., >10 Pascals).

____ If **YES**-check here, briefly document the issues below, and proceed to **Site-Specific Assessment-Question 6.**

____ If **NO**-check here, briefly document the rationale below and document on the Summary Page that the groundwater data indicate the **pathway is incomplete** and/or does not pose an unacceptable risk to human health. In order to increase confidence in the assessment that the pathway is incomplete, we recommend that soil gas data **also** be evaluated (**Question 4(g)**).

____ If sufficient data (of acceptable quality) are not available-check here, go to Summary Page and document that more information is needed, We recommend the next step be expeditious collection of the needed data in accordance with proper DQOs. Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Soil Gas Assessment:

Q4(g): Do measured or reasonably estimated soil gas concentration exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2 (c) (see Appendix D)? For more information on the use of data for this part, please see the section below entitled "How should data be used in this question?"

____ If **YES** (or if the detection limit for any constituents of potential concern is above the target concentration)-check here. Document representative soil gas concentrations on Table 2 and proceed to **Question 5**.

____ If **NO**-check here and proceed to **Question 4(h)**.

Q4(h): Is the **nature and extent of soil contamination adequately characterized** and has adequate demonstration been made the **soil gas sampling techniques used could reasonably detect and elevated concentration of vapors** if they were present in the site setting?

____ If **Yes**-check here and continue with **Question 4(i)** below.

____ If **No**-check here. Skip to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOs. Question 4 can then be revisited with the newly collect data to re-evaluate the completeness of the vapor intrusion pathway.

Q4(i): Are the site conditions and/or data limitations that may make the use of generic soil gas attenuation factors inappropriate? (We recommend that this consideration involve an appropriately scaled and updated Conceptual Site Model (CSM) for vapor intrusion (see Appendix B), as well as the proper DQOs (see Appendix A). We also recommend evaluation of the generic attenuation factors

used to develop the media-specific attenuation factors (see the section below entitles "What is in Tables 2(a), 2(b), and 2(c) and how did we develop them?" and Appendix F.))

Factors that, in our judgment, typically make the use of the generic soil gas attenuation factors inappropriate include:

- Shallow soil contamination vapor sources (e.g., less than 15 ft below foundation level), and one or more of the following:
  - Buildings with significant opening to the subsurface (e.g., sumps, unlined crawlspaces, earthen floors), or
  - Significant preferential pathways, either naturally occurring and/or anthropogenic (see discussion below under "What Should I Keep in Mind When Evaluating Data"), or
  - Buildings with very low air exchange rates (e.g., <0.25/hr) or very high-sustained indoor/outdoor pressure differentials (e.g., >10 Pascals).

____ If **YES**-check here, briefly document the issues below, and proceed to **site-Specific Assessment-Question 6**.

____ If **NO**-check here, briefly document the rationale below and document on the Summary Page that the soil gas data indicate the **pathway is incomplete** and/or does not pose an unacceptable risk to human health. In this case, no further assessment of the vapor intrusion pathway is recommended.

____ If sufficient data (of acceptable quality) are not available-check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOs or proceed to **Question 5**. When additional data are collected, Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Rationale and References(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

B Secondary Screening - Question #5: Semi-Site-Specific Screening

Q5(a): Do groundwater and/or soil gas concentrations for any constituents of potential concern exceed target media-specific concentrations by a factor great than 50? (Evaluation of limited site data in Question 5 allows the user to potential screen sites using target concentrations that are higher by a factor of up to 50 times greater that the generic target concentrations used in Question4. If observed concentrations are great than 50 times the generic target concentrations, we recommend expeditious site-specific evaluations.)

____ If **YES**-check here and briefly document the issues below and go to **Site-Specific Assessment-Question 6**.

____ If **NO**-check here and continue with **Questions 5(b)**.

Q5(b): Are there site conditions and/or data limitations under which we would recommend the use of semi-site specific attenuation factors (based on the Johnson-Ettinger Model)? (To determine whether use of the Johnson-Ettinger model is appropriate, we recommend the user consider an appropriately scaled and updated Conceptual Site Model (CSM) for vapor intrusion (see Appendix B0 and DQOS (se Appendix A). We also recommend user refer to Appendix G, which lists the limitations of the Johnson-Ettinger Model.)

Factor that, in our judgment, typically make the use of semi-specific attenuation factors inappropriate include:

- Very shallow vapor sources (e.g., depths less than 5 ft below foundations level); or
- Relatively shallow vapor sources (e.g., depths less than 15 ft below foundation level) and one or more of the following:
  - Building with significant openings to the subsurface (e.g., sumps, unlined crawlspaces, earthen floors), or
  - Significant preferential pathways, either naturally occurring and/or anthropogenic (see discussion in Question 4), or
  - Buildings with very low air exchange rates (e.g., <0.25/hr) or very high sustained indoor/outdoor pressure differentials (e.g., >10 Pascals), or
  - Soil types outside the range shown in Table 4, or
- Any other situation for which the Johnson-Ettinger Model is deemed inappropriate

____ If **YES**-check here and briefly document the issues below and go to **Site-Specific Assessment-Question 6**.

____ If **NO**-check here and continue with **Question 5(c)**.

____ If sufficient data (of acceptable quality) are not available-check here and skip to Summary Page and document that more information is needed. We recommend that the next step be expeditious collection of the needed data in accord with proper DQOs. Question 5 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Q5(c): Are the **depth to vapor source and the overlying unsaturated zone soil type adequately characterized** in areas with inhabited buildings (or areas with the potential for future development of inhabited buildings)?

____ If **YES**-check hare and continue with **Question 5(d)** below.

____ If **NO**-check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOS. Question 5 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Subsurface Source Identification

Q5(d): Is there any potential contamination (source of vapors) in the unsaturated zone at any depth above the water table? (In our judgment, if there is a contaminant source in the unsaturated zone, soil gas data are needed to evaluate the vapor intrusion pathway in the vicinity of the source and, consequently, use of the groundwater target concentrations may be inappropriate. However, we recommend that groundwater data still be evaluated, particularly if a contaminant plume extends beyond the unsaturated zone source, but that the evaluation be performed only in conjunction with an evaluation of soil gas data. Other vapor sources that we believe typically make use of groundwater target concentrations include: 1) those originating in landfills where methane may serve as a carrier gas; 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemcials' vapor may result in significant advective transport of the vapor downwards through cracks/openings in floors and into the vadose zone; and 3) leaking vapors from underground storage tanks. In these cases, diffusive transport of vapors is often overridden by advective transport and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.)

____ If **YES**-check here and skip to **Soil Gas Assessment-Question 5(f)** below.

____ If **NO**-check here and continue with **Groundwater Assessment-Question 5(e)** below.

Groundwater Assessment:

Q5(e): Do measured or reasonably estimated groundwater concentration exceed the target media-specific concentration given in Tables 3(a), 3(b), or 3 (c) for the appropriate attenuation factor (given that the conditions listed above in 5(b) are not present and the sampling issues described Appendix E have been considered)?

____ If **YES**-check here, document the soil type, depth to groundwater and attenuation factor used in the assessment on the summary page, document the representative groundwater concentrations on Table 3. If **soil gas data are available**, proceed to **Soil Gas Assessment-Question 5(f)** below, **otherwise** proceed to **Site Specific Assessment-Question 6**.

____ If **NO**-check here and document that the groundwater data indicate that the **pathway is incomplete** and/or does not pose an unacceptable risk to human health on the Summary Page. In order to increase confidence in the assessment that the pathway is incomplete, EPA recommends that soil gas data also be evaluated following the soil gas assessment guidelines below (**Question 5(f)**).

Soil Gas Assessment:

Q5(f): Do measured or reasonable estimated soil gas concentration exceed the target media-specific concentrations given in Tables 3(a), 3(b), or 3(c) for the appropriate attenuation factor (given that the conditions listed in above in 5(b) are not present, or that other site specific factors make consideration of this analysis inappropriate, and that sampling issues described in Appendix E have been considered)?

____ If **YES**-check here, document the soil type, depth to source and attenuation factor used in the assessment on the Summary Page, document representative soil gas concentrations on Table 3 and proceed to **Site Specific Assessment-Question 6.**

____ If **NO**-check here and document that the subsurface vapor to indoor air **pathway is incomplete** and/or does not pose an unacceptable risk to human health on the Summary Page. In this case, we recommend no further assessment of the vapor intrusion pathway.

Rationale for Selecting Semi-Site Specific Attenuation Factor and Reference(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

A Site-Specific Assessment – Question 6

Q6(a): Have the **nature and extent of contaminated soil vapor, unsaturated soil, and/or groundwater as well as potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?** (Consider an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B) and DQOs (see Appendix A)).

____ If **YES**-check here, briefly document the basis below and **proceed to Question 6(b)**. If a model was used, we recommend it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample.

____ If **NO**, or if insufficient data (of acceptable quality) are available-check here, briefly **document the needed data** below, and skip to the Summary Page and document the more information is needed. After collecting the additional data you can return to this question. However, **if indoor air data are available go to Question 6(e)**.

Q6(b): Are you conducting an EI determination and are you using an appropriate and applicable model?

____ If **YES**-check here and continue with **Question 6(c)** below.

____ If **NO**-check here and continue with **Question 6(d)** below.

Q6(c): Does the model predict an unacceptable risk? (EPA recommends that predictive model can be used to support Current Human Exposure Under Control EI determinations without confirmatory samplings to support this determination. Current Human Exposure Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and the current use conditions.)

____ If **YES**-check here and continue with **Question 6(d)** below.

____ If **NO**-check here and document that the Pathway **is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations. However, this determination does not necessarily reflect a final decision that the site is clean without confirmatory sampling.

Q6(d): Are subslab soil gas data available?

____ If **YES**-check here and continue with **Question 6(e)** below.

____ If **NO**-check here and continue with **Question 6(g)**.

Q9(e): Do measured subslab soil gas concentrations exceed the target shallow soil gas concentrations given in Tables 2(a), 2(b), or 2(c)?

____ If **YES**-check here, document representative subslab soil gas concentrations on Table 2, collect indoor air data and **go to Question 6(g)**.

____ If **No-**check here and **continue to Question 6(f)**.

Q6(f): Is the subslab sampling data adequate? (We recommend doing subslab sampling before indoor air sampling). Some factors we recommend for consideration in this question include:

- Do analytical results meet the required detection thresholds?
- Do the data account for the seasonal and/or temporal transience
- Do the data account for spatial variability?
- Is there any reason to suspect random (sampling) or systematic (analytical) error?
- How do the data account for the site conceptual model?
- Was "background" ambient (outdoor) air or other vapor sources considered?

____ IF **YES**-check here and document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health.

____ If **NO** or unsure-check here, briefly document the needed data below, and skip to the Summary Page and document that more information is needed. After collecting the additional data, return to Question 6(e).

Q6(g): Do measured indoor air concentration exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)? (We recommend that before any indoor air sampling occurs: 1) an inspection of the residence be conducted, 2) an occupant survey be complete to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emissions of target VOCs in the dwelling (see Appendices E, H, and I), 3) all possible indoor air emission sources be removed, and 4) that the analysis be done only for the constitutes of potential concern found on the site.)

____ If **YES**-check here, document representative indoor air concentrations on Table 2, and go to Question 6(i).

____ If **NO**-check here and continue to Question 6(h).

Q6(h): Do the indoor air concentrations adequately account for seasonal variability and represent the most impacted buildings or areas (see Appendix E)? Some factors we recommend for consideration in this question include:

- Do analytical results meet the required detection thresholds?
- Do the data account for the seasonal and/or temporal transience?
- Do the data account for spatial variability?
- Is their any reason to suspect random (sampling) or systematic (analytical) error?
- How do the data account for the site conceptual model?

____ If **YES**-check here, document that **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health. If a model was used to predict the indoor air concentrations also document the relationship between the predicted concentrations and the measured concentrations.

____ If **NO**-check here, go to the Summary Page and document that more information is needed. If the data do not account for seasonal variability, we recommend designing a sampling plan to account for seasonal variability, resample and return to Question 6(g). If the data do represent the most impacted building or area, skip

to the Summary Page and document that more information is needed. After collecting the additional data, you can return to Question 6(g).

Q6(i): Have background sources of vapor in indoor air and ambient (outdoor) air been adequately accounted for?

____ If **YES**-check here, document results and document that **Pathway is Compete**. If a model was used to predict the indoor air concentrations, also document the relationship between the predicted concentrations and the measured concentrations.

____ If **NO**-check here, briefly document the needed data below, and skip to the Summary Page and document that more information is needed. After collecting the additional data, you can return to Question 6(g).

Rationale and Reference(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

VII. VAPOR INTRUSION PATHWAY SUMMARY PAGE

Facility Name: **Charleston Naval Complex**
Facility Address: **PO BOX 190010**
North Charleston, South Carolina 29406
Facility EPA ID# **SC0 170 022 560**
Updated: **September 16, 2003**

Primary Screening Summary

- *Q1: Constituents of Concern Identified?*
  XXX *Yes*
  _____ *No* (If No, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

- *Q2: Currently inhabited buildings near subsurface contamination?*
  _____ *Yes*
  XXX *No*

  Areas of future concern near subsurface contamination?
  _____ *Yes*
  XXX *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

- *Q3: Immediate Actions Warranted?*
  _____ *Yes*
  _____ *No*

Secondary Screening Summary

- *Vapor source identified*
  _____ *Groundwater*
  _____ *Soil*
  _____ *Insufficient data*

- *Indoor air data available?*
  _____ *Yes*
  _____ *No*

- *Indoor air concentrations exceed target levels*
  _____ *Yes*
  _____ *No*

Subsurface data evaluation: (circle appropriate answers below)

Medium	**Q4 Levels Exceeded?**	**Q5 Levels Exceeded?**	**Data Indicates Pathway is Complete**
Groundwater	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS
Soil Gas	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS

NA = not applicable
INS = insufficient data available to make a determination

Site-Specific Summary

- *Have the nature and extent of subsurface contamination, potential pathways, and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?*

  ____ *Yes*
  ____ *No*
  ____ *N/A*

  EPA recommends that if a model was used, it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample. EPA recommends that predictive modeling can be used to support Current Human Exposure Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. Therefore, if conducting evaluation for an EI determination, document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations.

- *Are you making an EI determination based on modeling and does the model prediction indicate that determination is expected to be adequately protective to support Current Human Exposures Under Control EI determinations?*

  ____ *Yes*
  ____ *No*
  ____ *N/A*

- *Do subslab vapor concentrations exceed target levels?*

  ____ *Yes*
  ____ *No*
  ____ *N/A*

- *Do indoor air concentrations exceed target levels?*
  ____ *Yes*

____ *No*

Conclusion

Is there a Complete Pathway for subsurface vapor intrusion to indoor air?

XXX NO-the "Subsurface Vapor Intrusion to Indoor Air Pathway" has been verified to be incomplete, based on a review of the information contained in this EI Determination of Charleston Naval Complex facility, EPA ID # SC0 170 022 560 located at North Charleston, South Carolina under current and reasonably expected conditions, or based on performance monitoring evaluations for engineered exposure controls. This determination will be re-evaluated when the Agency/State becomes aware of any significant changes at the facility.

____ YES, The "Subsurface Vapor to Indoor Air Pathway" is Complete. Engineered controls, avoidance actions, or removal actions taken include:

____ UNKNOWN- More information is needed to make a determination.

Locations where References may be found:

Southern Division, Naval Facilities Engineering Command
Caretaker Site Office
1895 Avenue F
North Charleston, South Carolina

Contact telephone and E-mail numbers:

US Navy
(name): Rob Harrell
(phone #): (843) 743-2063
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(E-mail): Stampsjm@dhec.sc.gov

Reminder: As discussed above, this is a guidance document, not a regulation. Therefore, conclusions reached based on the approaches suggested in this guidance are not binding on EPA or the regulated community. If information suggests that the conclusions reached using the approaches recommended are inappropriate, EPA may (at it's own initiative or at the suggestion of interested parties) choose to act at variance with these conclusions.

References

Title	Author	Date
Project Team Notebook and Instruction	CH2M-Jones	December 2001
Background PAHs Study Report, Technical Information for Development of Background BEQ Values	CH2M-Jones	February 2001
Draft Report Preliminary RFI Field Activity (Soil-Gas, Geophysics)	EnSafe/Allen & Hoshall	15 February 1995
Final RCRA Facility Assessment	EnSafe/Allen & Hoshall	06 June 1995
Zone A RCRA Facility Investigation Report	EnSafe, Inc.	07 August 1998
Final RCRA Facility Investigation Report Zone B	EnSafe/Allen & Hoshall	21 November 1996
Final Zones A and B RFI Work Plan	EnSafe/Allen & Hoshall	06 September 1995
Zone C RCRA Facility Investigation Report Revision 0	EnSafe	14 November 1997
Final Zone D RCRA Facility Investigation Report	EnSafe/Allen & Hoshall	17 July 1997
Final Zones D, F, and G RFI Work Plan	EnSafe/Allen & Hoshall	13 June 1996
Draft Zone E RCRA Facility Investigation Report	EnSafe	November 1997
Final Zone E RFI Work Plan	EnSafe/Allen & Hoshall	02 June 1995
Zone F RCRA Facility Investigation Report	EnSafe	31 December 1997
Zone G RCRA Facility Investigation Report	EnSafe	20 February 1998
Zone H RCRA Facility Investigation Report	EnSafe	5 July 1996
Zone I RCRA Facility Investigation Report	EnSafe	1 March 1999
Zone K RCRA Facility Investigation Report	EnSafe	12 September 1996
Zone I CMS Workplan	CH2M-Jones	25 February 2003
SWMU 1 CMS Workplan	CH2M-Jones	15 June 2001
SWMU 2 CMS Workplan	CH2M-Jones	15 June 2001
SWMU 2 IM Completion Report	CH2M-Jones	15 February 2002

SWMU 3 RFI Report Addendum/IM Completion Report/CMS Workplan	CH2M-Jones	06 February 2003
SWMU 4 RFI Report Addendum	CH2M-Jones	28 August 2001
SWMU 5 RFI Report Addendum/IM Completion Report/CMS Workplan	CH2M-Jones	09 May 03
SWMU 6 RFI Report Addendum/ IM Completion Report/ CMS Workplan	CH2M-Jones	25 June 2003
SWMU 7 Groundwater Sampling and Analysis Plan	CH2M-Jones	12 July 2002
SWMU 8 CMS Report	CH2M-Jones	16 June 2003
Combined SWMU 9 CMS Report	CH2M-Jones	31 January 2003
SWMU 11 RFI Report	CH2M-Jones	28 August 2001
SWMU 14 CMS Workplan/IM Completion Report	CH2M-Jones	18 April 2003
SWMU 15 CMS Workplan/IM Completion Report	CH2M-Jones	25 February 2002
SWMU 17 Interim Progress Report MNA Pilot Test	CH2M-Jones	27 June 2003
SWMU 18 RFI Report/IM Completion Report/CMS Workplan	CH2M-Jones	09 May 2003
SWMU 21 RFI Report/IM Completion Report/CMS Workplan	CH2M-Jones	09 May 2003
RFI Report and CMS Workplan for Combined SWMU 70	CH2M-Jones	26 September 2002
CMS Report Combine SWMU 23	CH2M-Jones	23 May 2003
SWMU 24 CMS Report	CH2M-Jones	27 March 2003
SWMU 36 RFI Report Addendum and IM Completion Report	CH2M-Jones	05 March 2003
SWMU 38 IM Completion Report (Soil Removal)	CH2M-Jones	13 June 2002
SWMU 38 IM Completion Report (In-Situ Chemical Oxidation of DDD in Groundwater)	CH2M-Jones	30 September 2002
SWMU 39 Corrective Measure Implementation Plan	CH2M-Jones	26 June 2003

SWMU 42 CMS Workplan/IM Completion Report	CH2M-Jones	13 February 2003
SWMU 44CMS Workplan/IM Completion Report	CH2M-Jones	02 May 2002
SWMU 47 CMS Workplan	CH2M-Jones	14 May 2001
SWMU 53 CMS Report	CH2M-Jones	18 March 2003
SWMU 54 RFI Report Addendum/IM Completion Report/CMS Workplan	CH2M-Jones	09 May 2003
RFI Report Addendum and CMS Workplan for Combined SWMU 65	CH2M-Jones	17 June 2003
SWMU 67 RFI Report Addendum	CH2M-Jones	19 June 2003
SWMU 81 RFI Report Addendum	CH2M-Jones	26 August 2002
CMS Report Combined SWMU 83	CH2M-Jones	01 July 2003
SWMU 84 RFI Report and CMS Workplan	CH2M-Jones	09 May 2003
SWMU 97 RFI Report Addendum	CH2M-Jones	04 June 2002
SWMU 100 RFI Report Addendum	CH2M-Jones	14 May 2002
SWMU 102 RFI Report and CMS Workplan	CH2M-Jones CH2M	07 February 2003
SWMU 106 RFI Report Addendum	CH2M-Jones	24 August 2001
SWMU 109 RFI Report Addendum	CH2M-Jones	23 October 2001
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SWMU 145 RFI Report Addendum	CH2M-Jones	01 November 2001
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SWMU 162 RFI Report Addendum	CH2M-Jones	26 September 2001
SWMU 163 RFI Report Addendum	CH2M-Jones	22 March 2002
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SWMU 175 CMS Report	CH2M-Jones	07 July 2003
SWMU 181 RFI Report Addendum	CH2M-Jones	30 August 2002
SWMU 188 RFI Report Addendum	CH2M-Jones	30 August 2002
SWMU 196 CMS Report	CH2M-Jones	17 June 2003
AOC 505 CMS Workplan and IM Completion Report	CH2M-Jones	30 August 2002
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AOC 517 CMS Workplan	CH2M-Jones	16 July 2001
AOC 518 CMS Workplan	CH2M-Jones	02 July 2001
AOC 525 RFI Report Addendum	CH2M-Jones	01 November 2001
AOC 526 CMS Report	CH2M-Jones	18 March 03
AOC 528 CMS Report	CH2M-Jones	30 July 2002
AOC 530 and 531 CMS Report	CH2M-Jones	20 August 2002
AOC 537 RFI Report Addendum	CH2M-Jones	**30 August 2002**
AOC 538 and 539 RFI Report Addendum	CH2M-Jones	30 April 2003
AOC 550 RFI Report Addendum		19 September 2002
AOC 551 and 552 RFI Report Addendum		16 September 2002
AOC 559, 560, 561, and 570 CMS Report	CH2M-Jones	20 August 2002
AOC 563 RFI Report Addendum	CH2M-Jones	26 June 2003
AOC 566 and 567 RFI Report Addendum	CH2M-Jones	04 June 2002
AOC 569 RFI Report Addendum and CMS Workplan	CH2M-Jones	30 December 2002
AOC 569 IM Workplan	CH2M-Jones	10 March 2003
AOC 570 RFI Report Addendum and CMS Workplan	CH2M-Jones	30 December 2002
AOC 572 RFI Report	CH2M-Jones	06 June 2002

Addendum		
AOC 573 RFI Report Addendum and CMS Workplan	CH2M-Jones	30 April 2003
AOC 574 RFI Report Addendum and CMS Workplan	CH2M-Jones	09 May 2003
AOC 575 RFI Report	CH2M-Jones	21 August 2002
AOC 576 RFI Report Addendum	CH2M-Jones	19 June 2002
AOC 578 RFI Report Addendum and CMS Workplan	CH2M-Jones	30 December 2003
AOC 579 RFI Report Addendum	CH2M-Jones	28 March 2002
AOC 580 RFI Report Addendum	CH2M-Jones	04 June 2002
AOC 583 RFI Report Addendum	CH2M-Jones	19 August 2002
AOC 586 CMS Report	CH2M-Jones	26 February 2003
AOC 590 RFI Report Addendum and CMS Workplan	CH2M-Jones	07 February 2003
AOC 596 RFI Report Addendum and CMS Workplan	CH2M-Jones	09 May 2003
AOC 597 CMS Report	CH2M-Jones	14 January 2003
AOC 598 and 599 CMS Report	CH2M-Jones	30 May 2003
AOC 605 RFI Report/IM Completion Report/CMS Workplan	CH2M-Jones	09 May 2003
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AOC 609 RFI Report Addendum	CH2M-Jones	15 November 2001
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AOC 633 RFI Report and CMS	CH2M-Jones	16 March 2003

Workplan		
AOC 635 Groundwater Sampling and Analysis Plan	CH2M-Jones	12 July 2002
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AOC 653 CMS Investigation Report Addendum	CH2M-Jones	08 August 2001
AOC 670 CMS Workplan and IM Completion Report	CH2M-Jones	18 April 2003
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AOC 701 RFI Report Addendum	CH2M-Jones	04 October 2002
AOC 704 RFI Report Addendum	CH2M-Jones	05 August 2002
AOC 706 RFI Report Addendum and CMS Workplan	CH2M-Jones	30 May 2003
AOC 709 H RFI Report Addendum	CH2M-Jones	04 October 2001
AOC 709 F RFI Report Addendum	CH2M-Jones	16 August 2001